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Report Title:	**Techniques for Monitoring Avian Species On and Around Cotton Fields in Arizona as a Representative Area for the Southwestern United States**
Report Number:	ECO 95-132; MRID No. 44452615
Authors:	Sullivan, J.P., H.L. McQuillen, L.W. Brewer, and J.A. Gagne.

Report Summary

Techniques for Monitoring Birds in Cotton. A GLP study was carried out in southwestern Arizona, U.S.A. to test different techniques for monitoring the potential effects of crop protection chemical applications on birds on and around cotton fields. The study was based on the methods given by the U.S. Environmental Protection Agency for data requirement 40 CFR 158.145 Series 71-5 "Simulated and Actual Field Testing for Mammals and Birds." The objective of this study was to evaluate techniques for assessing the occurrence and mortality of bird species that utilized cotton fields and their immediate environs. The capability of the techniques to detect mortality was the primary evaluation criterion. Representative cotton fields and adjacent habitats were chosen in southwestern Arizona. Important secondary objectives of this study included documentation of bird species using monitored fields, bird activity on cotton fields, stomach contents as indicators of food items birds select and hence potential sources of oral exposure to crop protection chemicals, and the amount of time birds spent on cotton fields.

This study was intended to permit a statistical evaluation of differences in mortality estimates among cotton fields using radio-telemetry data. Comparisons of carcass searching results and density estimates were quantitative, but did not involve statistical analysis. This study was intended to determine whether techniques such as avian population census, behavioral observation, radio-telemetry monitoring, carcass searching, and crop or stomach content analysis can be combined to study sentinel bird species using a cotton agroecosystem-ecosystem to provide the sensitivity necessary to differentiate between naturally occurring background mortality and the potential mortality from a crop protection chemical.

The results of this study indicate that it is possible to monitor bird mortality following crop protection chemical applications to cotton by using an automated telemetry system. Telemetry, either an automated telemetry system or truck-mounted manual system, proved much more efficient than traditional carcass searching (78 - 94% vs. 12.5%) at locating marked carcasses. A major advantage of using telemetry is that one can monitor the amount of time birds spend on treated fields, whereas with traditional carcass searching, the potential exposure is unknown. The automated telemetry system used during this study allowed us to correctly determine potential exposure 80% of the time.

The Red-winged Blackbird is a suitable test species as long as they are present in adequate numbers on the study field, and they have not yet begun to gather in large flocks. Once they begin to flock, Red-winged Blackbirds become much more mobile and their site fidelity declines. The Cliff Swallow proved to be very difficult to capture and was present inconsistently on cotton fields. Therefore we do not consider it a good candidate for use as a test species in future studies. Depending on the region of the country in which any future study is conducted, various different species may also be appropriate (e.g. quail or doves).

Gastrointestinal content analysis indicated that red-winged blackbirds consumed a combination of vegetation and terrestrial and aquatic invertebrates. Birds were not often observed foraging within the cotton fields, but as the cotton grew, birds were not visible to the observer when they dropped into the cotton foliage. It should be assumed that birds in the foliage are most likely foraging.

Statistical comparisons among pairs of fields to evaluate differences in the amount of mortality were not possible because too few blackbirds were fitted with transmitters on different fields within each pair. However, bird use data for the paired fields do indicate that the fields within each pair were used by different numbers of birds and by different species of birds. Also, different numbers of birds were found dead on different members of the paired fields. This suggests despite efforts to choose fields as similar as possible, it is difficult for a human observer to choose fields *a priori* that will receive similar bird use.

Conclusion

The use of an automated telemetry system along with manual telemetry techniques greatly enhanced the ability to locate carcasses within the dense vegetation of a mature cotton field. Manual carcass searching was extremely difficult in the dense vegetation and high temperatures. Avian censuses indicate that despite efforts to chose fields of similar size and with similar surrounding habitats, different numbers and species of birds used the fields, therefore, it is difficult to select fields in an *a priori* fashion for suitable pairing of control and treated fields.

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Report Title: **An Avian Field Study to Assess the Potential for Acute Effects Occurring in Cotton Fields Treated with PIRATE® Insecticide-Miticide (AC 303630 in a 3SC Formulation)**

Report Number: ECO 96-238; MRID No. 44452616

Authors: Sullivan, J.P., H.L. McQuillen, L.W. Brewer, J.A. Gagne, and R.R. Troup.

Report Summary

Field Study Assessing the Effects on Birds in Cotton in Louisiana. A GLP study was carried out in northeastern Louisiana, U.S.A. to monitor the potential effects of crop protection chemical applications on birds on and around cotton fields. The study was based on the methods given by the U.S. Environmental Protection Agency for data requirement 40 CFR 158.145 Series 71-5 "Simulated and Actual Field Testing for Mammals and Birds." This study was designed: (1) To use avian censuses and carcass searching to determine whether PIRATE, applied according to the proposed label, may cause intoxication of, or mortality to, the various bird species associated with cotton fields; (2) To use censuses, and if possible other techniques, including radio telemetry, to determine if the proposed label, commercial applications of PIRATE may cause intoxication of, or mortality to, Blue Grosbeaks, Blue Jays, Brown Thrashers, Horned Larks, Indigo Buntings, Killdeer, Mourning Doves, Northern Bobwhite, Northern Cardinals, Northern Mockingbirds, and Red-winged Blackbirds resident in and around cotton fields, and (3) To quantify residues of AC 303630, the active ingredient in PIRATE, in food items of insectivorous, granivorous, omnivorous, and predatory birds associated with cotton fields. This study is designed to fulfill Subdivision E data requirement 71-5, Actual or Simulated Field Testing for Birds or Mammals.

From July 4, 1996, to September 14, 1996, an avian field study was conducted in Franklin and Catahoula Parishes, in northeast Louisiana, by Ecotoxicology and Biosystems Associates, Inc. for American Cyanamid Company. During the 1996 growing season, twelve commercial cotton fields were selected in Franklin and Catahoula Parishes, in northeast Louisiana. Eight fields were treated once with an aerial application of PIRATE at 0.35 lb a.i./A (Bate's New Level, Bringol's Haybarn, Crook-Knott's, Crook-Quinn by the Floodgate, Glen Carroll, New Ground 60, Pete Jackson, and Russell Back 40), while the remaining four fields were used as reference fields (Back-of-Fort, Carroll-Dixie River, Goodman, and Lee Parker). All twelve fields received normal maintenance crop protection chemicals at the discretion of the growers. All twelve fields were monitored for bird use and survival using avian censuses, carcass searching, and resighting of color-marked birds, and four fields, two treated (Glen Carroll and Bringol's Haybarn) and two reference (Back-of-Fort and Lee Parker), were monitored using a combination of radio telemetry field techniques.

While censusing birds, the habitat in which the birds were observed was recorded. The majority of observations (approximately 50%) were of birds along the edge of cotton and adjacent habitat. The second most frequent observations (approximately 30%) were birds flying. The total number of birds observed flying was a combination of those observed over the cotton crop and other habitat categories. The third greatest number of observations (approximately 13%) were made of birds in the cotton crop. The relatively low number of observations made within the cotton crop indicates that most birds were not using the crop as their primary habitat. If census data were used as representative of bird distribution through time, birds would be estimated to use the cotton no more than 13% of the time.

There was no apparent pattern to whether birds were seen in cotton or in the edge either before or after the application, suggesting that the application of PIRATE neither attracted nor repelled birds. ANOVA results for sightings in cotton ($F = 0.44$, $p = 0.65$) or in edge habitat ($F = 0.21$, $p = 0.81$) were not statistically different according to census day.

Avian census also revealed that bird abundance was not statistically different either before or after applications of PIRATE when comparisons are made among the treated and reference fields. F-values for single factor ANOVAs were <0.001 ($p = 0.98$), 1.825 ($p = 0.21$), and 2.56 ($p = 0.14$) when comparisons are made for the Day -1, 2, and 5 censuses, respectively. When comparisons were made among the treated fields only to determine whether abundance differed through time, there were no significant differences in bird abundance on Day -1, 2, or 5 ($F = 0.11$, $p = 0.89$). No pattern was evident through time with both high and low census counts occurring on fields that were included in the first, second, and third treatment groups. There is no evidence that applications of PIRATE affected the bird abundance on treated fields.

Avian species diversity was measured using Brillouin's Index. A ranking of overall diversity for the different study fields (from lowest to highest) would be Carroll-Dixie River (ref.), Bate's New Level (tr.), New Ground 60 (tr.), Goodman (ref.), Pete Jackson (tr.), Crook-Quinn by the Floodgate (tr.), Russell Back 40 (tr.), Lee Parker (ref.), Back-of-Fort (ref.), Bringol's Haybarn (tr.), Glen Carroll (tr.), and Crook-Knott's (tr.). Because the reference fields were dispersed throughout the ordered list, they should not be considered necessarily any more or less diverse than the treated fields. Mean diversity indices for reference and treated fields over time were 0.79 and 0.81 for Day -1, 0.71 and 0.78 for Day 2, 0.70 and 0.79 for Day 5, and 0.73 and 0.79 for overall diversity. Applications of PIRATE did not appear to affect species diversity on treated fields.

Species richness is the total number of species observed during each census. Species richness was variable among the study fields; however, no differences were noted for species richness between reference and treated fields on Day -1 ($F = 0.07$, $p = 0.80$), on Day 2 ($F = 1.21$, $p = 0.30$), or on Day 5 ($F = 2.83$, $p = 0.12$). When comparisons are made among the treated fields only to determine whether species richness differed through time, there were no significant differences in bird species richness on Day -1, 2, or 5 ($F = 0.19$, $p = 0.83$). Treating fields with PIRATE had no apparent affect on species richness.

Automated, hand-held and aerial telemetry were used to monitor presence, absence and survival of birds on two treated and two reference fields for the day of application and 21 days following application. The automated system was able to continuously monitor the field and determine the amount of time individual birds were present on or around the field. Portions of the adjacent habitat within range of the automated system were included in the calculation for the amount of time birds spent on or around the cotton fields. This is of tremendous value when attempting to assess whether exposure, when measured by amount of time spent on or around the field, is sufficient to cause mortality. If a bird is noted as present for little or no time on or around a field, the treatment to that field is less likely to impact the bird. Alternatively, if a bird spends large amounts of time on or around treated fields, and survives, the treatment of that field was not detrimental to the exposed bird's survival.

On either treated or untreated fields, those birds spending more time on the field did not appear any more likely to be effected or have an unknown fate than those spending less time on the field. Birds fitted with transmitters spent an average of 179.3 hrs [35.1% of total post-application monitoring time (TPAMT)] on or around Back-of-Fort (ref.), 119.2 hrs (23.7% TPAMT) on or around Glen Carroll (tr.), 85.2 hrs (20.5% TPAMT) on or around Bringol's Haybarn (tr.), and 93.5 hrs (21.3% TPAMT) on or around Lee Parker (ref.). For those birds categorized as alive, dead, or unknown, respectively, the birds that survived to the end of the study spent the most time on or around the field with average times spent of 323.8 (63.4% TPAMT), 337.6 (66.1% TPAMT), and 0.5 hrs (0.1% TPAMT) on or around Back-of-Fort (ref.); 276.1 (54.8% TPAMT), 28.1 (5.6% TPAMT), and 50.3 hrs (10.0% TPAMT) on or around Glen Carroll (tr.); 118.8 (28.6% TPAMT), NA (none died), and 34.9 hrs (8.4% TPAMT) spent on or around Bringol's Haybarn (tr.); and 160.3 (36.69% TPAMT), 95.2 (21.7% TPAMT), and 25.7 hrs (5.8% TPAMT) spent on or around Lee Parker (ref.).

The only field on which the average amount of time on the field for those birds surviving did not greatly exceed the average amount of time spent by the birds that died was Back-of-Fort (ref.). This field was not treated with PIRATE. This is very strong evidence that the degree to which birds are exposed to the treated area is not related to the probability of survival.

The Kaplan-Meier technique (White and Garrott 1990) was applied to the survival data for each pair of telemetry fields for three-day periods following the application of PIRATE. The variances (VAR(surv)) were tested for significant differences on both pairs of fields using the F-distribution (Rohlf *et al.* 1969). No significant difference was detected for any three-day period between the Back-of-Fort (ref.) and Glen Carroll (tr.) fields. There was no mortality on Bringol's Haybarn Field (tr.), therefore, there was no survival variance for this treated field and we did not need to test for significance. On both pairs of fields, survival of radio-tagged birds was numerically higher on treated fields. The exposure estimates from the automated telemetry system indicates that those birds that survived were exposed to PIRATE as much or more than the other birds. Therefore applications of the test material did not appear to place birds on or around cotton fields at any greater risk.

Of those birds equipped with radio transmitters, a total of 33 birds were present on the fields the day of test substance application, 20 on treated fields and 13 on controls.

The results from the telemetry indicate no mortality of radio-tagged birds directly attributable to the test substance following a single application of PIRATE at approximately the maximum label rate of 0.35 lb a.i./A. Survival of radio-tagged birds did not differ among treated and reference fields. Most importantly, there was no relationship between time spent on the fields following application and mortality.

A total of 229 individuals were color-marked with the first bird marked on July 4, 1996. The majority were Northern Cardinals. More than 10 Indigo Buntings, Northern Mockingbirds, and Red-winged Blackbirds were color-marked. Other species that had fewer than 10 individuals color-marked included Blue Grosbeaks, Blue Jays, Brown Thrashers, Killdeer, and Mourning Doves.

The target number of individuals of all species combined to be color-marked on each study field was 20. Adequate numbers of birds were color-marked, but very few were resighted on treated or reference fields following the applications. The low number of resightings prevented statistical analysis of that data.

Samples of cotton leaves were collected from all eight of the treated fields, however, two fields, Floodgate (tr.) and Russell Back 40 (tr.), did not possess sufficient stands of weeds within the field borders to allow collection of weed seed heads. The residues of PIRATE measured in the cotton leaf samples averaged 51.1 ppm with a range of 10.4 to 109 ppm. The residues of PIRATE measured in the weed seed head samples averaged 20.5 ppm with a range of 6.74 to 31.1 ppm. Insect residues were not collected due to a lack of availability of insects on the study fields.

No carcasses were located on reference fields. Five carcasses were found on treated fields following applications of PIRATE despite having an overall carcass search efficiency of 64%, indicating mortality rates following the applications were very low for treated and reference fields. The five carcasses found during routine post-application carcass searches were two Eastern Cottontails, one unidentified bird (only wings and feathers were found), and one Hispid Cotton Rat. One Ruby-throated Hummingbird was also found on a study field post-application during other study activities.

It is likely that the unidentified bird was the remains of a carcass used for search efficiency trials. The Hispid Cotton Rat mortality was determined to not likely be related to exposure to PIRATE because it was found close to a sprung snap trap (#9 on Russell Back 40 (tr.)) and during the post-mortem examination, a "blunt trauma with subcutaneous hemorrhage diagonally across the skull from left to right" was identified. It is believed that a glancing blow from the snap trap killed the animal, but failed to snare it.

Residue analysis of the two Eastern Cottontail stomach contents found 89.2 ppm and 29.4 ppm (samples 40049 and 70079, respectively). Residue analysis of the GI tracts found 4.80 ppm and 5.83 ppm (samples 40049 and 70079, respectively). Residue analysis of the livers found 1.64 ppm and 0.0562 ppm (samples 40049 and 70079, respectively). The Ruby-throated Hummingbird was too small for residue analysis.

Throughout the trapping effort, twelve small mammals were captured. Since twenty traps were set on each field for approximately 5 days (120 hrs), the trapping success *was only 0.012 animals/trap day. Such an extremely low trap success suggests that* small mammal populations using the cotton field borders is low.

One of the GI samples, number 90028 from a rat found on Pete Jackson (tr.), showed residues of 4.11 ppm. Residues in all other samples were $\leq$ 0.5 ppm. The limited degree to which small mammals appeared to possess residues of PIRATE and the apparent low numbers of small mammals available suggests that the potential for secondary exposure of raptors is low. This is further supported by the low numbers of raptors observed during the censuses.

Conclusions:

The relatively low number of observations made within the cotton crop indicates that most birds were not using the crop as their primary habitat. If census data were used as representative of bird distribution through time, birds would be estimated to use the cotton no more than 13% of the time. There was no apparent pattern to whether birds were seen in cotton or in the edge either before or after the application suggesting that the application of PIRATE neither attracted nor repelled birds.

The census data indicate that there is no evidence that applications of PIRATE affected the bird abundance on treated fields, further, applications of PIRATE did not appear to affect species diversity on treated fields, nor did treating fields with PIRATE have any apparent affect on species richness

The results from the telemetry indicate that following a single application of PIRATE, at approximately the maximum proposed label rate of 0.35 lb a.i./A, birds that survived to the end of the observation period spent, on average, more time on or around the cotton fields than those that died or had an unknown fate. Survival of radio-tagged birds also did not differ among treated and reference fields.

The limited degree to which small mammals appeared to possess residues of PIRATE and the apparent low numbers of small mammals available suggests that the potential for secondary exposure of raptors is low. This is further supported by the low numbers of raptors observed during the censuses.

The techniques used during this study indicated that neither bird use of fields nor bird survival were influenced by applications of PIRATE.

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Report Title:	**A Characterization of Avian Species On and Around Cotton Fields in the Cotton Belt of the United States**
Report Number:	ECO 95-129; MRID No. 44452614
Authors:	D. Temple, H. Krueger, J. Gagne

Report Summary

Bird Usage of Cotton Fields and Environs – A Second Look. A non-guideline GLP study was carried out three cotton growing regions across the Cotton Belt of the southern United States during the growing season in 1995. The same regions as were visited during a similar study during the growing season of 1993 were revisited. The objective of this study was to determine the abundance and composition of avian species found in and around cotton fields throughout the growing season. Other species of wildlife observed in the crop and adjacent habitats also were recorded. The fields chosen for the avian censuses represent a variety of cotton growing practices and adjacent habitat types.

All fields censused during this study were commercial cotton fields following normal agronomic practices for their respective locations. Data were collected from fields in Arizona, representative of the western United States; Texas, representative of the of the central U.S. cotton growing region; and from Alabama and Mississippi, representative of the southeastern U.S. portion of the Cotton Belt. Avian censuses were conducted in and adjacent to cotton fields during three census periods throughout the cotton growing season from June 8 to August 27, 1995. Twelve sites were chosen in each region, and six plots were located on each site. Each circular census plot measured 100 m in diameter and was composed of approximately 50% cotton field and 50% adjacent habitat. Censuses were conducted during morning hours. Each plot was generally surveyed for a total of eight minutes during each census. Each site was visited three times during each census period, alternating between early and late morning surveys, for a total of nine avian censuses per site. Avian abundance, species composition, and use of cotton fields and adjacent habitats were measured. Surveys of avian activity were also conducted on each replicate to collect information on the activities of birds in the cotton crop. One-hour surveys were conducted by a pair of biologists (an observer and a recorder). Activity surveys were conducted alternating between morning and evening time periods, with two surveys conducted during each census period, for a total of six activity surveys per site. Avian abundance, species composition, and use of cotton fields and adjacent habitats were measured.

Twelve cotton fields associated with three of the major habitat types in southwest Arizona were sampled. Fifty-four avian species were observed during 108 censuses with a mean of 48 individuals per census. Avian diversity on each site in Arizona, as measured by the Brillouin index, ranged from 0.34 to 1.10. Avian abundance in

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Arizona was highest on sites associated with riparian habitat (53.8 birds/census), followed by fallow grassland habitat (42.2 birds/census) and desert scrub habitat (41.2 birds/census). Avian abundance increased from 46 birds/census during Session I (June 13 to July 1) to 51 birds/census during Session II (July 5 to July 25) and returned to 46 birds/census during Session III (July 29 to August 15). Overall, 64%of birds observed within census plots during avian censuses were in or foraging above cotton fields. Avian use of cotton fields ranged from 62% during Session I and 60%in Session II to 69% in Session III. Avian use of cotton associated with the different habitat types, regardless of survey period, was 52%, 74% and 83% for riparian, fallow grassland and desert scrub sites, respectively. The most frequently observed species in Arizona were red-winged blackbird, Abert's towhee, cliff swallow, brown-headed cowbird, common yellowthroat, and lark sparrow.

Twelve cotton fields associated with three of the major habitat types in east Texas were sampled. Forty-seven avian species were observed during 107 censuses with a mean of 16 individuals observed per census. Avian diversity on each site, as measured by the Brillouin Index, ranged from 0.70 to 1.13. Avian abundance for cotton fields associated with different habitat types was 10.9, 20.7 and 23.8 birds/census for open pasture, bottomland hardwood and riparian habitats, respectively. Avian abundance decreased slightly from 17 birds/census during Session I (June 8 to June 30), to 16 birds/census in Session II (July 5 to July 26), and 15 birds/census during Session III (July 29 to August 16). Twenty-three percent of birds observed within survey census plots were in or foraging above cotton fields. Avian use of cotton fields increased from 21% during Session I, to 27% during Session II and 23% in Session III. Percent avian use of cotton associated with different habitat types was 11%, 19% and 37% for riparian, bottomland hardwood and open pasture sites, respectively. The most frequently observed species in Texas were northern cardinal, Carolina chickadee, barn swallow, painted bunting, and Carolina wren.

Twelve cotton fields associated with three of the major habitat types in Mississippi and Alabama were sampled. Fifty-four avian species were observed during 108 censuses with a mean of 29 individuals per census. Avian diversity on each site, as measured by the Brillouin Index, ranged from 0.86 to 1.16. Avian abundance was highest on sites associated with lowland hardwood habitat (33.2 birds/census), followed by bottomland woodland habitat (26.6 birds/census) and upland woodland habitat (22.1 birds/census). Avian abundance increased over the study period from 24 birds/census during Session I (June 18 to July 7) to 29 birds/census during Session II (July 11 to August 1) and 34 birds/census during Session III (August 6 to August 27). Nineteen percent of birds observed within survey plots were in or foraging above cotton fields. Avian use of cotton fields increased from 11% during Session I to 19% during Session II and 24% during Session III. Avian use of cotton associated with the different habitat types was 15%, 26% and 28% for bottomland woodland, lowland hardwood and upland woodland sites, respectively. The most frequently observed species in the Mississippi and Alabama region were northern cardinal, indigo bunting, blue jay, Carolina chickadee, chimney swift, and Carolina wren.

Of the three cotton growing regions, sites in Arizona had the highest overall avian abundance, more than one and one-half times that of the Mississippi and Alabama sites and more than three times of that observed in Texas. Avian use of cotton fields increased from Session I to Session III in all three study regions. Avian abundance peaked in Arizona during Session II, declined slightly from Session I to Session III in Texas and increased steadily in the Mississippi and Alabama region. Avian abundance and diversity were generally highest on sites associated with riparian and bottomland and lowland forested habitats. Overall diversity, as measured by the Brillouin Index. And species richness, was highest on sites in Mississippi and Alabama and lowest on desert scrub and fallow grassland sites in Arizona.

Hour-long avian activity surveys detailed the activity of species observed using the cotton crop. Thirty-one avian species were observed in Texas and 35 and 37 species were observed in Mississippi and Alabama region and Arizona, respectively. Red-winged blackbirds comprised 50% of the birds observed in Arizona and 43% of them were observed perching in the crop, which was the most frequently observed activity. Irrigation influenced the numbers of birds observed using the crop. Approximately 45 birds/survey were recorded during periods of irrigation, while 34 birds/survey were recorded at other times. Red-winged blackbirds comprised 75% of the birds observed during periods of irrigation and only 38% of the birds in the crop were red-winged blackbirds at other times. In Texas, 29% of the birds observed were dickcissels and 85% of these were observed singing or calling. Aerial foraging was the second most observed activity (24%) during surveys. In the Mississippi and Alabama region, 38% of the birds were observed perching and the most prevalent species recorded was indigo bunting (26%).

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Report Title:	**Quantification of Natural and Agricultural Environmental Characteristics Associated with Cotton Production in Brazos County, Texas and Leflore County, Mississippi Using Biosensing Incorporated Into a Geographic Information System**
Report Number:	ECO 93-138; MRID No. 44452606
Authors:	J.A. Gagne, R.R. Troup, C.G. Crabtree, S.A. Kay, and R.S. Pearson

Report Summary

Remote Sensing of Cotton and Adjacent Habitats—Pilot Study. A non-guideline, GLP study was carried out in cotton-growing regions in the southern United States. The utility of and methods for using a geographic information system (GIS) and remote sensing to measure and quantify aspects of the environment as part of a risk assessment and for environmental fate modeling were examined as part of this pilot study.

Two counties in the southern United States, Leflore County, Mississippi and Brazos County, Texas, were selected to represent wetland (non-irrigated) and dryland (irrigated) cotton growing regions, respectively. Satellite imagery was used to determine characteristics of cotton fields, their surrounding habitats, and the juxtaposition of cotton with surface water, both flowing and static. High resolution aerial images were used to closely evaluate the composition and characteristics of buffer vegetation surrounding bodies of water to assist in assessing drift potential from a crop protection chemical application to a cotton field into bodies of water. Existing soil type, hydrologic, elevational, and transportation data were combined with the remotely acquired data in a GIS to more fully describe cropping practices involving cotton so that the information could be included in run-off models.

The habitat classifications were 81% accurate in Brazos County and 89% accurate in Leflore County. The amount of land in cotton, other agricultural crops, native vegetation classes, water, and other (primarily cities, buildings, and roads) was determined. The percent of land in cotton and the distribution of cotton within the counties differed with more of the land in cotton in Leflore County (27% vs. 10%), and the cotton in Brazos County being more concentrated, within the Brazos River floodplain. Cotton field sizes were larger in Leflore County (average of 39.6 ha) than in Brazos County (22.3 ha), however cotton fields in both counties were relatively flat with slopes of generally less than 1%. The locations of the cotton fields could be combined with the distribution of different soil types within each county to determine which soil types were common for growing cotton. This can be important for evaluating the risk of run-off because soil type is critical for modeling run-off. The number of bodies of water

and their sizes were determined. The vast majority of bodies of water within each county were small, less than 2 ha. The vegetation surrounding bodies of water of different sizes was also determined. In both counties, much of the linear edge of the bodies of water, 40% in Brazos County and 81% in Leflore County, was adjacent to tall, dense vegetation. This type of vegetation is most effective at intercepting drift from crop protection chemical applications. The amount of avian habitat was determined within each county. Land use/land cover categories included as avian habitat included hardwoods, cypress, woodlands, brush, tall grass, grass/pasture, and riparian. It was acknowledged that cities, agricultural fields and open water could also be considered as avian habitat. In Leflore county, only 12% of the avian habitat, and in Brazos County, only 3% of the avian habitat were within 30 m of cotton. This kind of information helps to put into perspective the level of risk bird populations may be exposed to regarding crop protection chemical applications.

The results of this pilot study indicate that combining remotely acquired information (e.g. satellite and aerial images) with existing environmental data bases (e.g. soil, elevation, hydrology, etc) within a GIS can greatly enhance the understanding of how much cotton or any other crop may be adjacent to habitats of concern or to what extent the vegetation surrounding cotton fields, or bodies of water may mitigate risk of drift or run-off. The two counties selected showed marked differences in some aspects of cotton agriculture (such as adjacency to water) but were remarkably similar in others (such as slope of the fields). Knowledge of the extent and location of characteristics influencing the potential hazard a crop protection chemical may pose to birds or aquatic organisms helps to move the risk assessment process past many of the previously necessary "worst case" scenarios and allows for more realistic assessments based a better defined picture a "typical case".

Report Title:	**Quantification of Natural and Agricultural Environmental Characteristics Associated with Cotton Production Using Remote Sensing Incorporated Into a Geographic Information System (GIS) to Support Evaluation of AC 303630**
Report Number:	ECO 94-159; MRID No. 44452607
Authors:	Crabtree, C.G., J.A. Gagne, E.B. Henriksen, C.M. Holmes, S.A. Kay, B.D. McGaughey, R.S. Pearson.

Report Summary

Remote Sensing of Cotton and Adjacent Habitats—Definitive Study. A non-guideline, GLP study was carried out in cotton-growing regions all across the United States. The primary objective of this study was to quantify the environmental characteristics which influence exposure of birds and aquatic organisms resulting from the use of AC 303630 on cotton. Secondary objectives required to achieve this primary objective were: 1) Quantify environmental characteristics, such as cotton field characteristics, water body characteristics, aquatic buffer characteristics, and adjacency of sensitive habitats to cotton; and 2) Express these characteristics in a manner which allows inclusion in a risk assessment.

Twenty locations throughout the cotton-growing regions of the United States were selected, and sixteen were fully characterized. Only those areas within one mile of agricultural lands (including row-crops and tree crops) and within the political boundaries of the United States were included in the characterization to reduce the potential bias produced in the summary statistics from the inclusion of large, contiguous nonagricultural areas. Satellite imagery was used to determine characteristics of cotton fields, their surrounding habitats, and the juxtaposition of cotton with surface water, both flowing and static. The numbers of cotton fields, the total cotton acreage, the maximum, minimum and mean field size, total cotton field perimeter lengths, minimum, maximum, and mean perimeter lengths within each study site are all reported. Existing soil type, hydrologic, elevational, and transportation data were combined with the satellite data in a GIS to characterize the cotton fields according to their slope, soil type and the land cover classes within 10 m (33 ft) or 50 m (164 ft). The specific land cover classes, or habitats, differed among sites with a comprehensive listing appearing in the following table:

List of Land Use/Land Cover Classes and the sites where each class was observed.

	CA-1	AZ-1	AZ-2	TX-1	TX-4	TX-6	TX-7	OK-1	LA-1	LA-2	MS-1	TN-1	AL-1	GA-1	SC-2
Cotton	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Other Ag.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Forest Trees		x	x	x	x	x	x	x	x	x		x	x	x	x
Bottomland Forest											x				
Upland Forest											x				
Brush					x	x	x	x	x	x	x	x	x	x	x
Grass/Pasture		x	x	x	x	x	x	x	x	x	x	x	x	x	x
Desert Scrub	x	x	x	x											
Bare Ground/Urban	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Rivers/Streams	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Lakes/Ponds	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Int. Streams	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Canals	x	x	x	x	x	x	x	x	x			x	x		x
Wetlands	x				x		x		x	x	x	x	x	x	x
Catfish Ponds									x	x	x	x		x	
Mud Flats						x	x								
Bays							x								
Roads	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Clouds/Shadows	x					x	x		x		x	x	x		x

High resolution aerial images were used to closely evaluate the composition and characteristics of buffer vegetation surrounding bodies of water to assist in assessing drift potential from a crop protection chemical application to a cotton field into bodies of water. The buffer between any water body and cotton was characterized as tall dense vegetation, tall sparse vegetation, brush, bare ground/grass/urban, or roads.

The locations were grouped according to ecoregion as defined by Bailey (1996), and results compiled. Locations were analyzed representing the following ecoregions: Mediterranean (CA-1), Tropical/Subtropical Desert (AZ-1, AZ-2, TX-1), Tropical/Subtropical Steppe (OK-1, TX-6), Prairie (TX-4, TX-7), Subtropical (LA-1, LA-2, MS-1, AL-1, GA-1, SC-2), and Hot Continental (TN-1). Cotton agriculture differed among ecoregions. The numbers of cotton fields and the total acreage is most heavily determine by the number of locations included in each ecoregion. The largest mean field size was note in the Mediterranean ecoregion, and the smallest mean sizes were noted in the Hot Continental, Tropical/Subtropical Desert, and Subtropical ecoregions. Those ecoregions with the smaller field sizes also possessed the larger field area/perimeter ratios which could be suggestive of in which ecoregions the greatest proportion of field edge habitat could be exposed to drift.

	All	Mediterranean	Tropical/ Subtropical Desert	Tropical/ Subtropical Steppe	Prairie	Subtropical	Hot Continental
No. Cotton Fields	41,732	742	3,639	6,276	1,668	19,315	10,092
Cotton Acreage	1,450,652	191,935	97,324	285,446	94,782	534,178	246,987
Mean Cotton Field (acres)	35	259	27	45	57	28	24
Mean Field Perimeter (m)	1544	5229	1359	1839	2056	1399	1350
Field Area/Perimeter Ratio	44	20	50	41	36	50	56

Nineteen land cover classes were identified across all locations. The most common cover class across all locations was Forest/Trees (20%), with Other Agriculture (19%)

and Grass/Pasture (13%) also common. Cotton accounted for 13% of the area analyzed across all locations. The Hot Continental ecoregion possessed the greatest proportion of cotton acreage with 29% of the area analyzed being cotton followed by the Mediterranean ecoregion with 24%. The locations representing the Prairie ecoregion possessed the smallest proportion of the analyzed land area with cotton (5%). The prevalence of different land classes changed from one ecoregion to another.

	All	Mediterranean	Tropical/ Subtropical Desert	Tropical/ Subtropical Steppe	Prairie	Subtropical	Hot Continental
Forest/Trees (acres)	2,162,725 20%		14,710 2%	30,614 2%	110,019 6	1,890877 35	116,505 14
Other Agriculture (acres)	2,143,529 19%	162,441 21%	138,943 16%	433,843 30%	324,502 19	878,130 16	205,670 25
Cotton (acres)	1,431,532 13%	186,954 24%	95,801 11%	283 19%	91,813 5	530,119 10	243,132 29
Grass/Pasture (acres)	1,467,166 13%		23,413 3%	326,928 22%	555,042 32	416,534 8	145,249 18
Bare Ground/Urban (acres)	1,019,750 9%	196,473 25%	192,564 22%	129,956 9%	111,161 6	347,080 6	42,516 5
Brush/Weeds (acres)	961,742 9%			138,735 10%	285,744 16	511,451 10	25,812 3
Desert Scrub (acres)	569,075 5%	184,642 24%	384,433 44%	-	-	-	-
Clouds/Cloud Shadows (acres)	355,851 3%	19865 3%	0 0%	62,284 4%	68,400 4	204,244 4	1,058 <1
Roads (acres)	192,911 2%	12,902 2%	19,498 2%	27,743 2%	33,750 2	85,879 2	13,139 2
Lakes/Ponds (acres)	132,377 1%	4,833 1%	2,562 <1%	13,208 1%	29,234 2	78,414 1	4,126 <1
Wetlands (acres)	161,372 1%	2,896<1%	0 0%	-	8,527 <1	129,218 2	20,731 2
Rivers/Streams (acres)	57,384 1%	297 <1%	1,465 <1%	3,276 <1%	3,087 0	41,514 1	7,745 1
Bays (acres)	120,674 1%			-	120,674 7	-	-
Bottomland Forest (acres)	101,457 1%					101,457 2	-
Upland Forest (acres)	76,937 1%					76,937 1	-
Canals/Ditches (acres)	17,714 <1%	5,869 1%	7,112 1%	2,278 <1%	775 <1	1,212 <1	468 <1
Intermittent Streams (acres)	47,307 <1%	1,333 <1%	2,030 <1%	4,004 <1%	5,442 <1	32,350 1	2,148 <1
Mud Flats (acres)	5,948 <1%			220 <1%	5,676 <1	-	-
Catfish Ponds (acres)	35,014 <1%					34,862 1	152 <1

In general, cotton is grown on relatively flat land, with the vast majority on fields with <1% slope. This will result in reduced run-off potential. Less than 3% of the fields exhibited greater than 3% slope.

	All	Mediterranean	Tropical/ Subtropical Desert	Tropical/ Subtropical Steppe	Prairie	Subtropical	Hot Continental
0 – 1% slope (acres)	1,233,588 85%	168,190 88%	88,319 91%	259,089 91%	86,080 91	473,251 89	158,64 64
1 - 2% slope (acres)	167,373 12%	16,362 9%	6,702 7%	23,475 8%	6,048 6	50,498 9	64,788 26
2 - 3% slope (acres)	32,106 2%	4,164 2%	1,261 1%	2,280 1%	1,770 2	6,517 1	16,114 7
3 - 4% slope (acres)	10,147 1%	1,565 1%	1,043 1%	604 <1%	555 1	1,693 <1	4,687 2
4 - 5% slope (acres)	5,257 <1%	1,654 1%			329 <1	535 <1	2,739 1
5 – 7% (acres)	526 <1%					526 <1	-
>7% slope (acres)	267 <1%					267 <1	-

The most common land cover class adjacent to cotton fields across all locations is Other Agriculture with Grass/Pasture being the second most common. Only in the Tropical/Subtropical Steppe ecoregion was a different land cover class the most common with Grass/Pasture accounting for 55% of the area within 33 ft of cotton and 35% of the area within 164 ft of cotton. No aquatic habitat was common in close proximity of cotton fields. The prevalence Other Agriculture, Bare Ground/Urban, and Roads as the adjacent areas suggests that many drift zones are comprised of primarily "poor" avian habitats.

	All	Mediterranean	Tropical/ Subtropical Desert	Tropical/ Subtropical Steppe	Prairie	Subtropical	Hot Continental
33 ft zone around cotton							
Other Agriculture (acres)	63,556 39%	3,777 36%	5,364 55%	1,739 12%	3,803 38	30,228 38	18,652 50
Grass/Pasture (acres)	35,020 22%		255 3%	7,728 55%	2955 29%	15,455 19%	8,627 23%
Roads (acres)	19,603 12%	2,532 24%	1,825 19%	2,477 18%	1,333 13%	8,420 11%	3,016 8%
Bare Ground/Urban (acres)	17,323 11%	2,341 22%	1,708 18%	1,421 10%	250 2%	10,135 13%	1,468 4%
Brush/weeds (acres)	8,140 5%			300 2%	579 6%	6,345 8%	916 2%
Forest/Trees (acres)	7,419 5%		47 <1%	87 1%	136 1%	5,128 6%	2,021 5%
Intermittent Streams (acres)	4,199 3%	106 1%	24 <1%	255 2%	41 <1%	2,605 3%	1,168 3%
Canals/Ditches (acres)	2,344 1%	1,354 13%	669 7%	76 1%	100 1%	107 <1%	38 <1%
Clouds/Cloud Shadow (acres)	1,297 1%	249 2%	0 0%	12 <1%	839 8%	166 <1%	31 <1%
Rivers/Streams (acres)	1,799 <1%	9 <1%	0 0%	11 <1%	3 <1%	344 <1%	1,432 4%
Desert Scrub (acres)	425 <1%	87 1%	338 3%	-		-	-
Bottomland Forest (acres)	222 <1%			-	-	222 <1%	-

	All	Mediterranean	Tropical/ Subtropical Desert	Tropical/ Subtropical Steppe	Prairie	Subtropical	Hot Continental
Lakes/Ponds (acres)	168 <1%	8 <1%	1 <1%	18 <1%	1 <1%	78 <1%	62 <1%
Wetlands (acres)	164 <1%		0 0%	-	-	155 <1%	9 <1%
Upland Forest (acres)	35 <1%			-	-	35 <1%	-
Catfish Ponds (acres)	7 <1%			-	-	6 <1%	1 <1%
Mud Flats (acres)	0 0%			0 0%	-	-	-
Bays (acres)	0 0%			-	-	-	-
164 ft. Zone around Cotton							
Other Agriculture (acres)	214,030 36%	12,075 37%	18,037 48%	19,055 27%	21602 53%	91,663 32%	51,598 41%
Grass/Pasture (acres)	114,363 19%		877 2%	25,002 35%	9,321 23%	45,239 16%	33,924 27%
Bare Ground/Urban (acres)	89,933 15%	12,236 37%	11,266 30%	11,805 16%	707 2%	43,991 15%	9,096 7%
Forest/Trees (acres)	60,705 10%		277 1%	920 1%	590 1%	44,652 15%	14,266 1%
Brush/weeds (acres)	41,107 7%			2,831 4%	2,195 5%	30,596 11%	5,485 4%
Roads (acres)	40,532 7%	3,986 12%	3,603 10%	7,963 11%	2468 6%	16,448 6%	6,064 5%
Intermittent Streams (acres)	7,734 1%	149 <1%	108 <1%	492 1%	119 <1%	5,065 2%	1,801 1%
Clouds/Cloud Shadow (acres)	7,059 1%	1,040 3%	0 0%	2,660 4%	832 2%	768 <1%	169 <1%
Desert Scrub (acres)	6,355 1%	1,017 3%	2,688 7%	-	-	2,650 1%	-
Canals/Ditches (acres)	5,468 1%	2,128 7%	2,282 6%	538 1%	213 1%	229 <1%	78 <1%
Rivers/Streams (acres)	4,811 1%	27 <1%	1 <1%	91 <1%	19 <1%	1,951 1%	2,722 2%
Bottomland Forest (acres)	3,857 1%				-	3,857 1%	-
Lakes/Ponds (acres)	1,785 <1%	42 <1%	14 <1%	191 <1%	18 <1%	1,152 <1%	368 <1%
Wetlands (acres)	1,195 <1%		0 0%	-	-	994 <1%	201 <1%
Upland Forest (acres)	417 <1%				-	417 <1%	-
Catfish Ponds (acres)	141 <1%				-	138 <1%	3 <1%
Mud Flats (acres)	0 0%			-	-	-	-
Bays (acres)	0 0%				-	-	-

The majority of the overall area contributing to Lakes/Ponds was found in a relatively small number of larger water bodies. The pattern was consistent across all ecoregions except for the Hot Continental ecoregion in which the spread was fairly even. All ecoregions showed a consistent inverse relationship between the size of the Lakes/Ponds to the number within each size class.

	All	Mediterranean	Tropical/ Subtropical Desert	Tropical/ Subtropical Steppe	Prairie	Subtropical	Hot Continental
Lakes/Ponds – Area (acres)							
0.25 – 1.0-acre	2,851 2%	37 1%	65 3%	272 2%	328 1%	1,589 2%	560 14%
1.0 – 2.5-acre	4,521 3%	36 1%	76 3%	245 2%	343 1%	3,187 4%	634 16%
2.5 – 5.0-acre	5,483 4%	41 1%	139 6%	623 5%	683 2%	3,439 4%	558 14%
5.0 – 10-acre	9,212 7%	100 2%	210 8%	1,567 12%	1,398 5%	5,418 7%	519 13%
10 – 25-acre	13,387 10%	359 7%	333 13%	1,462 11%	2,370 8%	8,294 11%	569 14%
>25-acre	96,421 73%	4,254 88%	1,704 67%	9,003 68%	23,933 82%	56,421 72%	1,106 28%
Lakes/Ponds (No.)							
0.25 – 1.0-acre	6,565 44%	95 45%	153 44%	1,086 57%	782 37%	3,284 39%	1,165 57%
1.0 – 2.5-acre	3,223 21%	25 12%	57 16%	181 9%	310 15%	2,164 26%	486 24%
2.5 – 5.0-acre	1,703 11%	13 9%	46 13%	180 9%	209 10%	1,056 13%	199 10%
5.0 – 10-acre	1,506 10%	14 7%	30 9%	245 13%	241 11%	869 10%	107 5%
10 – 25	1,023 7%	24 11%	30 9%	115 6%	202 10%	594 7%	58 3%
>25	1,105 7	38 18%	33 9%	103 5%	365 17%	432 5%	44 2%

Terrestrial avian habitat was defined as all non-agricultural and non-aquatic land classes. Both a 33-ft and a 164-ft wide area around any body of water or patch of avian habitat were analyzed for the amount of cotton. The 33-ft wide buffer area around bodies of water contained little cotton, except for the areas around ditches and canals. An exception was that cotton was more frequently within 33 ft of Intermittent Streams in the Hot Continental ecoregion. The pattern was similar for the 164-ft buffer areas except that the percentages of the area containing cotton increased. The areas within 33 ft of avian habitat contained relatively little cotton, but the areas within 164 ft of avian habitats generally contained 20% or more cotton.

	All	Mediterranean	Tropical/ Subtropical Desert	Tropical/ Subtropical Steppe	Prairie	Subtropical	Hot Continental
% of 33-ft Adjacent area Containing Cotton							
Canals/Ditches	13%	19%	7%	18%	10%	6%	6%
Intermittent Streams	7%	7%	1%	5%	1%	6%	28%
Rivers/Streams	3%	4%	1%	2%	0%	1%	14%
Wetlands	1%	0%	-	-	-	1%	<1%
Bays	<1%	-	-	-	-	-	-
Avian Habitat	8%	7%	5%	9%	4%	8%	13%
% of 164-ft Adjacent area *Containing Cotton*							
Canals/Ditches	16%	20%	12%	21%	12%	5%	8%
Intermittent Streams	8%	8%	1%	6%	1%	8%	34%

	All	Mediterranean	Tropical/ Subtropical Desert	Tropical/ Subtropical Steppe	Prairie	Subtropical	Hot Continental
Rivers/Streams	5%	6%	4%	3%	0%	2%	18%
Wetlands	2%	0%	-	-	-	3%	2%
Bays	<1%	-	-	-	-	-	-
Avian Habitat	20%	22%	18%	19%	8%	20%	32%

The areas around bodies of water of different size classes were analyzed for the amount of cotton present. In general, very little cotton was present within 33 ft or 164 ft of lakes or ponds. Only the Tropical/Subtropical Steppe ecoregion possessed very considerable quantities (>10% for any size class) of cotton within the area around lakes or ponds.

	All	Mediterranean	Tropical/ Subtropical Desert	Tropical/ Subtropical Steppe	Prairie	Subtropical	Hot Continental
% of 33-ft Adjacent Areas containing cotton							
0.25 – 1.0	1%	2%	0%	2%	0%	0%	4%
1.0 – 2.5	1%	0%	0%	5%	0%	0%	4%
2.5 – 5.0	1%	0%	0%	7%	0%	0%	3%
5.0 – 10	2%	8%	0%	7%	0%	1%	3%
10 – 25	2%	6%	0%	12%	0%	1%	2%
>25	<1%	0%	0%	2%	0%	0%	<1%
% of 164-ft Adjacent Areas containing cotton							
0.25 – 1.0	3%	3%	1%	3%	0%	1%	8%
1.0 – 2.5	3%	4%	1%	5%	0%	2%	8%
2.5 – 5.0	3%	3%	1%	8%	0%	2%	6%
5.0 – 10	3%	8%	1%	7%	0%	2%	6%
10 – 25	3%	6%	0%	14%	0%	3%	5%
>25	1%	0%	0%	3%	0%	1%	1%

The amount of buffer according to different vegetative structures were measured between cotton and aquatic habitats to assess the potential for drift reaching aquatic habitats. In all ecoregions, the minimum buffer distance was 0 m. The two ecoregions with the minimum buffer distances were the Mediterranean and Tropical/Subtropical Desert ecoregions, most likely because of the predominance of the canals and ditches in the vicinity of cotton fields in these two ecoregions.

	All	Mediterranean	Tropical/ Subtropical Desert	Tropical/ Subtropical Steppe	Prairie	Subtropical	Hot Continental
Buffer between Ag. and Aquatic Habitats							
Min buffer	0	0	0	0	0	0	0
Max Buffer	45	23	35	50	50	43	50
Mean Buffer	18	7	11	21	21	19	17
Min. Tall Dense Veg.	9	-	8	<2	10	<2	<2
Max Tall Dense Veg.	40	-	15	43	28	43	50
Mean Tall Dense Veg.	17	-	9	16	15	19	15
Min. Tall Sparse Veg.	8	4	<2	-	-	8	2
Max Tall Sparse Veg.	22	6	15	-	-	21	27
Mean Tall Sparse Veg.	12	5	6	-	-	12	9

	All	Mediterranean	Tropical/ Subtropical Desert	Tropical/ Subtropical Steppe	Prairie	Subtropical	Hot Continental
Min. Brush	<2	<2	<2	<2	<2	<2	<2
Max. Brush	41	16	23	50	50	41	42
Mean Brush	13	7	7	17	17	14	9
Min. Bare Ground-Grass	<2	<2	<2	<2	<2	<2	<2
Max Bare Ground-Grass	41	13	22	50	49	41	50
Mean Bare Ground-Grass	13	6	8	16	17	12	12
Min. Road	4	<2	3	<2	<2	2.6	<2
Max. Road	33	23	14	47	33	33	40
Mean Road	9	7	7	11	10	7.4	9

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Table: Bird Species and Biology Information

Common Name	Region(s)	Average Body Weight (g)	Breeding Season	Feeding Guild	Detailed feeding information
American crow	TX-7, OK-1, TN-1, AL-1, GA-1, SC-1, *Census: SE*	M: 426 - 624 F: 418 - 596	February - July	granivore	75% vegetable - grain seeds, fruits, nuts other - millipedes, spiders, crustaceans, insects
American golden-plover	MS-1, TN-1	M: 138 - 166 F: 146 - 166	Late May - Mid August	omnivore	terrestrial invertebrates, berries, leaves, seeds
American goldfinch	OK-1, TN-1	M: 11.3 - 15.2 F: 11.4 - 14.0	May - August	omnivore	seeds of many annual plants, grasses, and trees (alder, birch, elm)
American kestrel	CA-1, AZ-2, TX-4, OK-1, MS-1, TN-1, SC-1, Census: TX	M: 99.3 - 113.5 F: 120.6	early April - July	insectivore	grasshoppers, crickets, beetles, mice, small mammals
American pipit	CA-1, AZ-2, TX-1, TN-1	M: 19.2 - 25.5 F: 18.6 - 23.2	Early June - Mid August	insectivore, granivore	terrestrial and freshwater invertebrates and seed
barn owl	CA-1, AZ-1	M: 475 F: 569	February - July	carnivore	small mammals, a few birds
Bewick's wren	AZ-2, TX-1, TX-4, TX-7, Census: TX	M: 21.5 F: 18.6	March - July	insectivore	97% small insects and spiders
black-chinned hummingbird	OK-1 Census: TX	M,F: 3.12	CA: April - Oct. TX: April - July	nectarivore, insectivore	nectar, flying insects
black-headed grosbeak	AZ-2, TX-1, Census: AZ, TX	M: 35 - 46 F: 37 - 48.8	Mid April - Late July	omnivore	grains, wild fruits, weed seeds, beetles, other insects
black-throated blue warbler	SC-1	M: 9.0 - 9.8 F: 8.7 - 10.1	Early May - Late August	insectivore	weevils, flies, spiders, fruits
black vulture	TX-4, TX-7, SC-1	M,F: 2043 - 2724	January - July	scavenger	baby herons, ducks, calves, skunks, opossums, carrion from dumps
blue grosbeak	TX-4, TX-7, TN-1, AL-1, GA-1, SC-1, Census: AZ, TX, SE	M: 29.3 F: 27.5	April - August	omnivore	insects: grasshoppers, beetles, true bugs plants: wheat, oats, rice, corn, alfalfa seeds
bobolink	TN-1, AL-1, GA-1, SC-1	M: 33.9 - 51.7 F: 29.2 - 39.9	May - August	insectivore	breeding season: adult and larval insects winter: vegetation dominates
Botteri's sparrow	AZ-2	M: 19.0 - 22.9 F: 17.4 - 25.5	Mid June - Mid September	omnivore	insects, especially Orthoptera, and seed
Brewer's blackbird	CA-1, AZ-1, AZ-2		February - July	omnivore	crickets, grasshoppers, caterpillars cereals (wheat)
Brewer's sparrow	AZ-2		April - August	omnivore	winter: weed seeds summer: weed seeds along with insects and spiders
bronzed cowbird	AZ-2, TX-7			omnivore	maize, other cereals caterpillars
brown-headed cowbird	CA-1, TX-1, TX-4, TX-7, OK-1, MS-1, TN-1, AL-1, GA-1, SC-1, Census: AZ, TX, SE	M: 40.2 -47.5 F: 32.0 - 37.6	April - August	omnivore	75% "weed" seeds 25% animal matter - grasshoppers and beetles
brown thrasher	TX-4, MS-1, TN-1, AL-1, GA-1, SC-1, Census: SE	49.6 - 78.0	March - August	omnivore	spring: insects, spiders, worms summer/fall: fruits, acorns, waste corn
burrowing owl	AZ-1, TX-1, Census: AZ	M: 146.3 - 148.8 F: 149.7 - 156.1	Mid March - Late August	carnivore	arthropods, small mammals, birds, amphibians, reptiles

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Common Name	Region(s)	Average Body Weight (g)	Breeding Season	Feeding Guild	Detailed feeding information
California thrasher	CA-1		March - June	insectivore, frugivore	insects, spiders, berry seeds, hazelnuts, weed seeds, small fruits
California towhee	CA-1		March - October	omnivore	seeds, grains, insects
Canada goose	CA-1	1816 - 5448	begins early March	omnivore, granivore	winter/migration: grasses, agricultural crops other times: insects, larvae, mollusks
Canada warbler	TX-4, TX-7, Census: SE	7.1 - 14.2	May - July	insectivore	spiders and insects
Carolina wren	TX-4, TX-7, MS-1, TN-1, AL-1, GA-1, SC-1, Census: TX, SE	M: 21.5 F: 18.6	Late March - Oct.	insectivore	Lepidoptera, Hemiptera, Coleoptera, arachnids seeds of bayberry, poison ivy, and other "weeds"
cattle egret	TX-7, MS-1, TN-1, AL-1, SC-1	M: 295.8 - 460.3 F: 270.0 - 512.0	April - October	carnivore	grasshoppers, crickets, spiders, flies, frogs, moths
chestnut-collared longspur	AZ-2	M: 19.8 F: 20.1	Early May - Early August	granivore	seeds, insects, spiders
chipping sparrow	TX-1, TX-4, TN-1, SC-1, Census: TX, SE	9.4 - 21.3	March - Sept.	insectivore	open meadows - seeds and insects
clay-colored sparrow	TX-4, TX-7	M: 9.8 - 12.8 F: 10.8 - 14.5	Early June - Mid August	omnivore	seeds and invertebrates
common grackle	OK-1, Census: AZ, TX, SE	M: 119.6 - 131.4 F: 92.2 - 100.8	Early March - Early July	insectivore	insects invertebrates, grain, tree seeds, some fruit
common ground-dove	TX-7, Census: AZ, SE		TX: March - Nov. AZ : May - Nov. SE: Feb - Nov.	granivore	roadsides, fields - small seeds, berries, insects
common nighthawk	OK-1, Census: TX	79.3	TX: March - July	insectivore	nocturnal - flying insects (mosquitoes, ants, gnats, moths)
Cooper's hawk	AZ-2, TX-7	M: 281 - 349 F: 439 - 566	Late March - Mid July	carnivore	sub-adult birds (robins, jays,) medium size mammals (chipmunks)
crested caracara	TX-7	M: 995 - 1305 F: 1095 - 1355	December - May	carnivore, scavenger	Insects, vertebrates (fish, reptiles, birds, mammals), eggs, carrion
dickcissel	TX-4, TX-7, OK-1, MS-1, TN-1, Census: TX, SE	28.4 - 49.7	April - Sept.	omnivore	vegetable materials - weed seeds and grains some insects
eastern meadowlark	AZ-2, TX-1, TX-4, TX-7, OK-1, MS-1, TN-1, SC-1, Census: TX, SE	M: 83 - 113 F: 75 - 100	Late March - Aug.	insectivore	75% insects - crickets and grasshoppers winter - weed seeds and waste grains (corn)
European starling	OK-1	M: 75.5 - 97.0 F: 75.0 - 89.0	Mid April - Early July	omnivore	snails, earthworms, millipedes, arachnids
field sparrow	TX-4, TN-1, SC-1	M: 13.1 F: 13.0	Late April - Late August	omnivore	winter: >90% grass seeds summer: <50% grass seeds, the rest are insects
fox sparrow	CA-1	28.4 - 49.7	May - August	frugivore, granivore	summer: insects, seeds winter: grasses
golden-crowned sparrow	CA-1		May - July	omnivore	seeds, plant shoots, buds, flowers small insects
grasshopper sparrow	AZ-2, TX-4, TN-1, Census: TX	M: 17.17 F: 18.38	Early June - Mid August	insectivore	insects - primarily grasshoppers
gray catbird	TX-4, TX-7, TN-1, AL-1, GA-1, SC-1, Census: SE	23.2 - 56.5	April - June	insectivore	ants, beetles, grasshoppers, chironomids, and moths also small fruits

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Common Name	Region(s)	Average Body Weight (g)	Breeding Season	Feeding Guild	Detailed feeding information
great blue heron	CA-1, Census: SE	M: 2480 F: 2110	March - August	carnivore	fish, insects, mammals, amphibians, crustaceans
great egret	CA-1	908 - 1135	LA: Feb. - Aug. other: April - Aug.	carnivore	forages in swamps and streams - fish, frogs, salamanders, snakes, snails
greater roadrunner	AZ-1, Census: AZ, TX	M: 280 - 380 F: 278-297	Early April - mid November	insectivore, carnivore	insects, scorpions, snakes, lizards, birds, up to 10% plant material
greater white-fronted goose	CA-1	M: 2221 - 3000 F: 1809 - 2700	Early May - Late August	omnivore, granivore	seeds, grains, grasses, berries
great-tailed grackle	OK-1, Census: AZ, TX		March - July	omnivore	shallow water - grains, berries, mollusks, crustaceans, insects, small fish, young birds
green jay	TX-7	79.0	Early April - Late July	omnivore	arthropods, vertebrates, seeds, fruits
groove-billed ani	TX-7	M: 70.9 - 99.3 F: 70.9	anytime	insectivore	pasture, fields - grasshoppers, termites, roaches
Harris' sparrow	OK-1	M: 37.4 - 37.9 F: 33.2 - 33.7	June - July	omnivore	seeds, fruits, arthropods, conifer needles
hooded warbler	TX-7, AL-1, GA-1, SC-1, Census: SE	M: 10.3 - 11.9 F: 9.7 - 11.3	Mid May - Early August	insectivore	Insects, arthropods, spiders, caterpillars, moths, grasshoppers
horned lark	CA-1, AZ-1, AZ-2, TX-1, TX-7, OK-1, MS-1, TN-1, Census: AZ, TX, SE	M: 30 -42 F: 31 - 40	January - July	granivore, insectivore	seeds and insects - ranges from 1% animal matter in the winter to <90% in summer when the young are fed insects exclusively
house finch	CA-1, OK-1, Census: AZ, TX	M: 15.7 - 26.9 F: 15.7 - 26.7	March - August	omnivore	buds, seeds, fruits (97% vegetable matter)
house sparrow	AZ-1, Census: AZ, TX	M: 28.6 F: 28.4	Early March - Late September	omnivore	cereal grains and weed seeds
house wren	AZ-2, TX-4, TN-1	9.4 - 14.2	April - August	insectivore	98% insects
indigo bunting	TX-4, TX-7, MS-1, TN-1, AL-1, GA-1, SC-1, Census: TX, SE	M: 14.97 F: 14.38	early May - Sept.	omnivore	breeding season: spiders, caterpillars, grasshoppers, winter: grass seeds
Kentucky warbler	TX-4, TX-7, TN-1, SC-1, Census: SE	14.2	May - July	insectivore	gets food from foliage of leaves: spiders and insects
killdeer	CA-1, AZ-1, AZ-2, TX-1, TX-7, MS-1, TN-1, AL-1, GA-1, SC-1, Census: TX, SE	85.1	March - August	insectivore	moist ground or shallow water - insects, grasshoppers, beetles, dragonflies
lark bunting	AZ-2, TX-4, Census: TX	37.7	May - Oct.	granivore	summer: grasshoppers other times: seeds of weeds and grass
lark sparrow	CA-1, AZ-2, TX-1, TX-7, OK-1	28.4	April - August	omnivore	soft bodied insects and seeds
lesser goldfinch	AZ-2, TX-1, Census: TX		April - Sept.	omnivore	seeds, fruits, flowers, few insects
Lewis's woodpecker	CA-1	106.4	CA: April - July	omnivore	spring /summer: flying insects winter/fall: fruits, berries, acorns
loggerhead shrike	CA-1, Census: AZ, TX	35 - 58.5	Early February - Late July	carnivore	arthropods, amphibians, reptiles, small mammals, birds, carrion
long-billed curlew	CA-1	794.5 - 908	April - June	omnivore	beetles, grasshoppers, larvae, crabs, berries

Common Name	Region(s)	Average Body Weight (g)	Breeding Season	Feeding Guild	Detailed feeding information
long-billed thrasher	TX-7		April - July	insectivore, frugivore	antlions, ants, beetles, bugs, termites, spiders, hackberries
MacGillivray's warbler	AZ-2, TX-1	10.4	Early May - Mid August	insectivore	bugs, leaf hoppers, beetles, wasps, ants
mallard	CA-1	M: 78.0 F: 69.2	March - August	omnivore	in ponds, lakes, grainfields, meadows seeds, insects, nuts, mollusks, tadpoles, frogs
Mississippi kite	OK-1	M: 212.8 - 269.6 F: 276.7 - 340.5	March - July	insectivore	grasshoppers, locusts, cicadas, katydids, beetles, dragonflies
mourning dove	CA-1, AZ-2, TX-1, TX-7, OK-1, MS-1, TN-1, SC-1, Census: AZ, TX, SE	M: 116 - 130 F: 108 - 123	Feb. - Oct.	granivore	cereal grains: corn, wheat, sorghum,. peanuts seeds of herbaceous plants and grasses
Nashville warbler	TX-7, TN-1	M: 7.0 - 13.9 F: 6.7 - 11.1	Mid May - Late July	insectivore	insects (flies, young grasshoppers, locusts, plant lice)
northern bobwhite	TX-7, OK-1, TN-1, AL-1, GA-1, SC-1, Census: TX	161.7 - 198.6 (Heavier in the north)	TX: March - Sep. other: April - Oct.	omnivore	seeds, fruits, buds are 90% of diet in winter, 70% in summer. Plant leaves, insects are rest of diet
northern cardinal	AZ-2, TX-7, MS-1, TN-1, AL-1, GA-1, SC-1, Census: TX, SE	35.5 - 56.8	March - Sept.	omnivore	vegetable matter on ground: grains, seeds, fruits, small amounts of insects
northern mockingbird	OK-1, Census: AZ, TX, SE	M: 51.5 F: 47.2	Feb. - Sept.	insectivore, omnivore	adults: 50% arthropods, 50% fruits breeding season: 85% from insects
olive sparrow	TX-7		March - October	omnivore	little has been reported; forages on ground
orange-crowned warbler	TX-4, TN-1	M: 9.4 F: 9.2	Late March - Late July	omnivore	invertebrates, berries, fruits
orchard oriole	TX-4, TX-7, MS-1, TN-1, AL-1, GA-1, SC-1	20.9	March - July	insectivore	beetles, flies, cabbage worms, grasshoppers few berries
ovenbird	TX-4, TX-7, TN-1, SC-1	M: 17.8 - 27.5 F: 18.4 - 25.8	Mid May - Late July	insectivore	forest invertebrates
painted bunting	TX-1, TX-4, TX-7, AL-1, GA-1, SC-1, Census: TX	14.2	March - August	omnivore	vegetable matter - seed heads of grass few insects and spiders
pauraque	TX-7		March - July	insectivore	moths, beetles, locusts, bugs
purple martin	AZ-2, TX-1, TX-7, MS-1, TN-1, AL-1, GA-1, SC-1, Census: AZ	49.6	March - August	insectivore	flying insects, spiders
red-tailed hawk	CA-1, AZ-2, TX-4, OK-1, MS-1, TN-1, AL-1, GA-1, SC-1	M: 1028 F: 1224	Late Feb. - July	carnivore	East & Midwest US: voles, mice, rats, cottontails North and West US: hares, jackrabbits, squirrels
red-winged blackbird	OK-1, Census: AZ, TX, SE	M: 70.5 F: 43.8	April - June	insectivore	non-breeding: plant matter breeding: animal matter
ring-necked pheasant	CA-1	M: 76.6 F: 59.6	April - September	omnivore	waste grains, seeds of weed and grass, acorns, birds, fleshy fruit, insects, snakes, mice
rock wren	AZ-2, TX-1, Census: AZ		January - August	insectivore	unvegetated sites - insects and spiders
ruby-throated hummingbird	OK-1, Census: SE	M: 3.0 - 3.4 F: 3.2 - 3.8	Mid March - Late August	nectarivore, insectivore	nectar from flowers mosquitoes, spiders, gnats, small bees

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Common Name	Region(s)	Average Body Weight (g)	Breeding Season	Feeding Guild	Detailed feeding information
rufous-crowned sparrow	AZ-2		March - September	omnivore	nesting season: insects and spiders other seasons: seeds
rufous-sided towhee	AZ-2, TX-1, TN-1, AL-1, GA-1, SC-1, Census: SE	28.3 - 49.6	April - September	omnivore	70% vegetable matter - acorns, weed seeds, fruit insects, spiders, snails
sandhill crane	CA-1, TX-1, TX-4, OK-1	F: 3460 -4450 M: 3950 - 4890	January - August	omnivore	cultivated grains, berries, insects, small mammals
savannah sparrow	CA-1, AZ-1	17.6 - 25.1	Early June - Late August	omnivore	small seeds, fruits, insects, eggs
Say's phoebe	AZ-1, Census: AZ		March - August	insectivore	grasshoppers, some berries
scissor-tailed flycatcher	TX-7, OK-1, Census: TX		April - August	insectivore	insects, fruits, berries, seeds
snow goose	CA-1	M: 2751 - 3359 F: 2497 - 2724	June - August	omnivore, granivore	winter wheat, waste grains, roots
song sparrow	AZ-2, MS-1, Census: AZ, SE	19.0	February - September	insectivore	wide varieties of vegetable and animal matter breeding season: insects
Swainson's hawk	CA-1, TX-1, TX-4, TX-7, OK-1, Census: TX	M: 693 - 936 F: 937 - 1367	Early April - Late July	carnivore	mammals, birds, fish, salamanders, frogs, snakes, insects
tundra swan	CA-1	M: 7200 F: 6300	Early May - Late September	omnivore, granivore	aquatic vegetation, waste grains, winter cereal crops, small amt. of animal matter
turkey vulture	CA-1, AZ-1, AZ-2, TX-4, TX-7, OK-1, MS-1, TN-1, AL-1, GA-1, SC-1, Census: TX	M: 2071 - 2383 F: 1986 - 2326	March - July	scavenger	carrion - small mammals, reptiles, amphibians, birds, fish
upland sandpiper	TX-4, TX-7, Census: TX	141.9	May - July	insectivore	forage in low grass - grasshoppers, crickets, weevils, ants, berries, seeds
varied bunting	AZ-2		April - August	omnivore	no definitive studies; likely insects, seeds, berries
veery	TX-7, SC-1	32.4	Mid May - July	insectivore	breeding season: insects late summer/fall: fruit
vesper sparrow	AZ-1	21.3 - 28.4	April - September	insectivore	seeds from weeds and grass, waste grains insects
western kingbird	CA-1, AZ-1, OK-1, Census: AZ, TX	M: 38.5 F: 37.3	Early March - Late June	insectivore	insects, elderberries, hawthorn, Texas mulberry
western meadowlark	CA-1, AZ-1, AZ-2, OK-1, Census: AZ	M: 106 F: 89.4	Late March - August	insectivore	winter: grain and weed seeds summer: beetles, weevils, grasshoppers, crickets
whimbrel	CA-1	M: 345 - 459 F: 310 - 404	Mid May - Late August	omnivore	
white-crowned sparrow	CA-1, AZ-2	M: 27.3 F: 25.5	May - August	granivore	weed seeds, small grains, fruit
white-eyed vireo	TX-4, TX-7, MS-1, TN-1, AL-1, GA-1, SC-1, Census: SE	M: 11.5 F: 11.7	April - August	insectivore	breeding: moths, butterflies, caterpillars, flies, beetles winter: plant matter dominates
white-tailed hawk	TX-7	880 - 1235	Late January - Late August	carnivore	small vertebrates (mammals, birds, reptiles, amphibians) arthropods
white-tailed kite	CA-1	294.0 - 346.2	Early February - Early August	carnivore	small mammals, birds, lizards, insects

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Common Name	Region(s)	Average Body Weight (g)	Breeding Season	Feeding Guild	Detailed feeding information
Wilson's warbler	TX-1, TX-4, TX-7, Census: TX	7.1	CA: April - ?	insectivore	93% insects also spiders, fruit pulp
wrentit	CA-1			omnivore	food from bark of shrubs - insects, spiders small fruit
yellow-breasted chat	AZ-2, TX-1, TX-4, TX-7, MS-1, TN-1, AL-1, GA-1, SC-1, Census: AZ, SE	21.3 - 28.4	AZ: April - Sept. CA: May-mid Aug.	insectivore	insects, berries, fruits
yellow-headed blackbird	OK-1, Census: AZ, TX	M: 57.0 F: 56.0	May - July	omnivore	breeding season: insects fall/winter: cultivated grains and weed seeds
yellow-rumped warbler	CA-1, Census: SE	9.4 - 21.3	April - August	omnivore	winter: berries other times: insects

Report Title:	**CL 303630: Monitoring of Cotton Fields and Surrounding Habitat to Establish the True Environmental Concentration of CL 303630 Residues in Cotton Plants, Soil, and Avian Food Items in Adjacent Avian Habitat After Multiple Ground Applications of AC 303630 3SC Insecticide-Miticide. (MS, 1994)**
Report Number:	RES 96-039; MRID No. 444452605
Authors:	T. Mahl; C. Elenewski; C. Snipes (SRD); F. Kennedy (ABC); T. Bixler (MTI)

Report Summary

The purpose of this study is to determine the environmental concentration of CL 303630 residues in cotton plants, soil, and avian food items in adjacent avian habitats after treatment with AC 303630 3SC insecticide-miticide applied in three sequential applications. The study protocol, amendments, and deviations containing the appropriate information to fulfill this purpose are included in Appendix A.

The field portion of this study was conducted in Leland, Mississippi in Washington County at a test site with a silty clay texture. AC 303630 3SC insecticide-miticide was applied in three applications to cotton (variety DES 119). The rate of application averaged 0.35 lb a.i./A in approximately 12-13 gallons of spray solution per acre, for a total rate applied of 1.04 lb a.i./A. From the control and treated plots, cotton plant and trash samples were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2478. The method has a validated sensitivity (Limit of Quantitation, LOQ) of 0.05 ppm.

Soil samples were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2201 with a LOQ of 10 ppb. From avian habitats adjacent to the control and treated plots, avian food samples consisting of weed seed heads were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2478.

All residue values, summarized in Tables I-VI, are discussed in greater detail in the analytical results section. Summaries of the data for all analyses, including concurrent recoveries, are found in Appendix B (ABC analytical report #43059), Appendix C (ABC analytical report #42564), and Appendix D (MTI analytical report #A011.179).

The analytical results for the cotton samples showed average apparent residues declined from 12.54 ppm at 0.1 DAT1 (days after first treatment) to average apparent residues of 3.88 ppm at 35 DAT3. The resulting analytical values for the cotton from

the control plot showed apparent residues of CL 303630 at or below 0.014 ppm in all commodities examined. The Limit of Detection (LOD) was estimated to be 0.005 ppm for this study.

Total apparent soil residues of CL 303630 had an average high of 231 ppb 0.1days after the second application (0.1DAT2). After the first application, average apparent residues of CL 303630 were found at every interval in the "A" layer (0-3 inches) ranging from 231 to 34 ppb. The "B" layer (3-6 inches) had an apparent residue of CL 303630 higher than the LOQ of 10 ppb at the 0.1 DAT2, 13 DAT2, 0.1 DAT3, and 14 DAT3 intervals. The "C" layer (6-12 inches) had an apparent residue of CL 303630 higher than the LOQ of 10 ppb at the 0.1 DAT2, 13 DAT2, and 0.1 DAT3 intervals. In control soil, apparent residues of CL 303630 were always at or below 1.96 ppb. The LOD was estimated to be 1.20 ppb for this study.

The analytical results for the avian food samples showed average apparent residues in the 0-10 ft sampling band declined from 0.81 ppm at 14 DAT3 to 0.09 ppm at 63 DAT3. The average apparent residues in the 10-25 ft sampling band declined from 0.58 ppm at 14 DAT3 to 0.10 ppm 63 DAT3 and apparent residues in the 25-50 ft sampling band declined from 0.39 ppm at 14 DAT3 to 0.08 at 63DAT3. The resulting analytical values for the avian food from the control plot showed apparent residues of CL 303630 at or below 0.035 ppm in all commodities examined. The LOD was estimated to be 0.005 ppm for this study.

Each spray tank solution was analyzed in duplicate by ACCO personnel using Method M 2260. Monitoring of each application was performed by taking duplicate tank-mix samples before and after the applications. Concentrations of CL 303630 in tank mix samples taken before and after each application averaged 89% (S.D. = 10), 75% (S.D. = 3), and 95% (S.D. = 5) of theory for each of the three applications, respectively. These samples were analyzed to assess homogeneity and stability of the test substance during application. Analytical results for these analyses are presented in Table VII.

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Report Title:	**CL 303630: Monitoring of Cotton Fields and Surrounding Habitat to Establish the True Environmental Concentration of CL 303630 Residues in Cotton Plants, Soil, and Avian Food Items in Adjacent Avian Habitat After Multiple Ground Applications of AC 303630 3SC Insecticide-Miticide. (MS, 1994)**
Report Number:	RES 96-040; MRID No. 44452605
Authors:	T. Mahl, C. Elenewski; C. Snipes (SRD); F. Kennedy (ABC); T. Bixler (MTI)

Report Summary

The purpose of this study is to determine the environmental concentration of CL 303630 residues in cotton plants, soil, and avian food items in adjacent avian habitats after treatment with AC 303630 3SC insecticide-miticide applied in three sequential applications. The study protocol, amendments, and deviations containing the appropriate information to fulfill this purpose are included in Appendix A.

The field portion of this study was conducted in Tribbett, Mississippi in Washington County at a test site with a loam texture. AC 303630 3SC insecticide-miticide was applied in three applications to cotton (variety Stoneville LA 887). The rate of application averaged 0.35 lb a.i./A in approximately 12-13 gallons of spray solution per acre, for a total rate applied of 1.05 lb a.i./A. From the control and treated plots, cotton RAC samples (plants and trash) were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2478. The method has a validated sensitivity (Limit of Quantitation, LOQ) of 0.05 ppm.

Soil samples were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2201 with a LOQ of 10 ppb. From avian habitats adjacent to the control and treated plots, avian food samples were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2478.

All residue values, summarized in Tables I-VI, are discussed in greater detail in the analytical results section. Summaries of the data for all analyses, including concurrent recoveries, are found in Appendix B (ABC analytical report #42942), Appendix C (ABC analytical report #42707), Appendix D (ABC analytical report 427071), and Appendix E (MTI analytical report #A011.194).

The analytical results for the cotton samples showed average apparent residues declined from 9.67 ppm at 0.1 DAT1 (days after first treatment) to average apparent residues of 0.74 ppm at 39 DAT3. The resulting analytical values for the cotton from

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the control plot showed apparent residues of CL 303630 at or below 0.006 ppm in all commodities examined. The Limit of Detection (LOD) was estimated to be 0.005 ppm for this study.

Total apparent soil residues of CL 303630 declined from an average high of 514 ppb 11 days after the third application (11 DAT3) to an average of 268 ppb at 130 days after the third treatment (130 DAT3). After the first application, average apparent residues of CL 303630 were found at every interval in the "A" layer (0-3 inches) ranging from 514 to 89 ppb. The "B" layer (3-6 inches) had an apparent residue of CL 303630 higher than the LOQ of 10 ppb at the 0.1 DAT2, 14 DAT2, 0.1 DAT3, 11 DAT3, and 130 DAT3 intervals. The "C" layer (6-12 inches) had an apparent residue of CL 303630 higher than the LOQ of 10 ppb at the 14 DAT1, 0.1 DAT3, 11 DAT3, and 130 DAT3 intervals. In control soil, apparent residues of CL 303630 were always at or below 1.79 ppb. The LOD was estimated to be 1.27 ppb for this study.

The analytical results for the avian food samples showed average apparent residues in the 0-10 ft sampling band declined from 0.39 ppm at 0.1 DAT2 to 0.08 ppm at 69 DAT3. The average apparent residues in the 10-25 ft sampling band declined from 0.25 ppm at 0.1 DAT3 to 0.08 ppm 69 DAT3 and apparent residues in the 25-50 ft sampling band declined from 0.22 ppm at 14 DAT1 to 0.08 at 69 DAT3. The resulting analytical values for the avian food from the control plot showed apparent residues of CL 303630 at or below 0.014 ppm in all commodities examined. The LOD was estimated to be 0.003 ppm for this study.

Each spray tank solution was analyzed in duplicate by ACCO personnel using Method M 2260. Monitoring of each application was performed by taking duplicate tank-mix samples before and after the applications. Concentrations of CL 303630 in tank mix samples taken before and after each application averaged 91% (S.D. = 7), 88% (S.D. = 9), and 87% (S.D. = 3) of theory for each of the three applications, respectively. These samples were analyzed to assess homogeneity and stability of the test substance during application. Analytical results for these analyses are presented in Table VII.

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Report Title:	**CL 303630: Monitoring of Cotton Fields and Surrounding Habitat to Establish the True Environmental Concentration of CL 303630 Residues in Cotton Plants, Soil, and Avian Food Items in Adjacent Avian Habitat After Multiple Aerial Applications of AC 303630 3SC Insecticide-Miticide. (MS, 1994)**
Report Number:	RES 96-041; MRID No. 44452605
Authors:	T. Mahl; C. Elenewski; C. Snipes (SRD); F. Kennedy (ABC); T. Bixler (MTI)

Report Summary

The purpose of this study is to determine the environmental concentration of CL 303630 residues in cotton plants, soil, and avian food items in adjacent avian habitats after treatment with AC 303630 3SC insecticide-miticide applied in three sequential applications. The study protocol, amendments, and deviations containing the appropriate information to fulfill this purpose are included in Appendix A.

The field portion of this study was conducted in Elizabeth, Mississippi in Washington County at a test site with a clay texture. AC 303630 3SC insecticide-miticide was applied in three applications to cotton (variety DES 119). The rate of application averaged 0.36 lb a.i./A in approximately 1.80-1.97 gallons of spray solution per acre, for a total rate applied of 1.08 lb a.i./A. From the control and treated plots, cotton plant and trash samples were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2478. The method has a validated sensitivity (Limit of Quantitation, LOQ) of 0.05 ppm.

Soil samples were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2201 with a LOQ of 10 ppb. From avian habitats adjacent to the control and treated plots, avian food samples consisting of weed seed heads were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2478.

All residue values, summarized in Tables I-VI, are discussed in greater detail in the analytical results section. Summaries of the data for all analyses, including concurrent recoveries, are found in Appendix B (ABC analytical report #43058), Appendix C (ABC analytical report #42608), and Appendix D (MTI analytical report #A011.196).

The analytical results for the cotton samples showed average apparent residues declined from 13.35 ppm at 0.1 DAT1 (days after first treatment) to average apparent residues of 4.92 ppm at 34 DAT3. The resulting analytical values for the cotton from

the control plot showed apparent residues of CL 303630 at or below 0.019 ppm in all commodities examined. The Limit of Detection (LOD) was estimated to be 0.005 ppm for this study.

Total apparent soil residues of CL 303630 had an average high of 394 ppb 14 days after the second application (14 DAT2) and declined to an average of 148 ppb at 62 DAT3. After the first application, average apparent residues of CL 303630 were found at every interval in the "A" layer (0-3 inches) ranging from 291 to 27 ppb. The "B" layer (3-6 inches) had an apparent residue of CL 303630 higher than the LOQ of 10 ppb at the 14 DAT2 and 0.1 DAT3 intervals. The "C" layer (6-12 inches) had an apparent residue of CL 303630 higher than the LOQ of 10 ppb at the 0.1 DAT2, 14 DAT2, and 0.1 DAT3 intervals. In control soil, apparent residues of CL 303630 were always at or below 2.08 ppb except for sample 0112A which averaged 2250 ppb. The Limit of Detection (LOD) was estimated to be 1.29 ppb for this study.

The analytical results for the avian food samples showed average apparent residues in the 0-25 ft sampling band declined from 7.32 ppm at 0.1 DAT2 to <0.05 ppm at 62 DAT3. The average apparent residues in the 25-75 ft sampling band declined from 2.34 ppm at 0.1DAT2 to 0.06 ppm 62 DAT3 and apparent residues in the 75-150 ft sampling band declined from 0.26 ppm at 14 DAT2 to <0.05 at 28 DAT3. The resulting analytical values for the avian food from the control plot showed apparent residues of CL 303630 at or below 0.054 ppm in all commodities examined. The Limit of Detection (LOD) was estimated to be 0.003 ppm for this study.

Each spray tank solution was analyzed in duplicate by ACCO personnel using Method M 2260. Monitoring of each application was performed by taking duplicate tank-mix samples before and after the applications. Concentrations of CL 303630 in tank mix samples taken before and after each application averaged 95% (S.D. = 2), 92% (S.D. = 3), and 80% (S.D. = 5) of theory for each of the three applications, respectively. These samples were analyzed to assess homogeneity and stability of the test substance during application. Analytical results for these analyses are presented in Table VII.

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Report Title: CL 303630: Monitoring of Cotton Fields and Surrounding Habitat to Establish the True Environmental Concentration of CL 303630 Residues in Cotton Plants, Soil, and Avian Food Items in Adjacent Avian Habitat After Multiple Aerial Applications of AC 303630 3SC Insecticide-Miticide. (MS, 1994)

Report Number: RES 96-042; MRID No. 44452605

Authors: T. Mahl; C. Elenewski; C. Snipes (SRD); F. Kennedy (ABC); T. Bixler (MTI)

Report Summary

The purpose of this study is to determine the environmental concentration of CL 303630 residues in cotton plants, soil, and avian food items in adjacent avian habitats after treatment with AC 303630 3SC insecticide-miticide applied in three sequential applications. The study protocol, amendments, and deviations containing the appropriate information to fulfill this purpose are included in Appendix A.

The field portion of this study was conducted in Burdett, Mississippi in Washington County at a test site with a clay texture. AC 303630 3SC insecticide-miticide was applied in three applications to cotton (variety DPL 50). The rate of application averaged 0.35 lb a.i../A in approximately 2 gallons of spray solution per acre, for a total rate applied of 1.05 lb a.i../A. From the control and treated plots, cotton plant and trash samples were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2478. *The method has a validated sensitivity (Limit of* Quantitation, LOQ) of 0.05 ppm.
Soil samples were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2201 with a LOQ of 10 ppb. From avian habitats adjacent to the control and treated plots, avian food samples consisting of weed seed heads were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2478.

All residue values, summarized in Tables I-VI, are discussed in greater detail in the analytical results section. Summaries of the data for all analyses, including concurrent recoveries, are found in Appendix B (ABC analytical report #43004), Appendix C (ABC analytical report #42808), Appendix D (ABC analytical report #428081), and Appendix E (MTI analytical report #A011.192).

The analytical results for the cotton plant and trash samples showed average apparent residues declined from 8.51 ppm at 0.1 DAT1 (days after first treatment) to average apparent residues of 1.08 ppm at 11 DAT3. The resulting analytical values for the

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cotton from the control plot showed apparent residues of CL 303630 below 0.008 ppm in all commodities examined. The Limit of Detection (LOD) was estimated to be 0.005 ppm for this study.

Total apparent soil residues of CL 303630 declined from an average high of 311 ppb 51 days after the third application (51 DAT3) to an average of 21 ppb at 111 days after the third treatment (111 DAT3). After the first application, average apparent residues of CL 303630 were found at every interval in the "A" layer (0-3 inches) ranging from 311 to 21 ppb. The "B" layer (3-6 inches) did not have an apparent residue of CL 303630 higher than the LOQ of 10 ppb. The "C" layer (6-12 inches) had an apparent residue of CL 303630 higher than the LOQ of 10 ppb at the 0.1 DAT1, 14 DAT2, 0.1 DAT3, and 22 DAT3 intervals. In control soil, apparent residues of CL 303630 were always at or below 6.00 ppb. The LOD was estimated to be 1.25 ppb for this study.

The analytical results for the avian food samples showed average apparent residues in the 0-25 ft sampling band declined from 1.76 ppm at 0.1 DAT2 to 0.06 ppm at 51 DAT3. The average apparent residues in the 25-75 ft sampling band declined from 0.90 ppm at 0.1DAT1 to 0.08 ppm 51 DAT3 and apparent residues in the 75-150 ft sampling band declined from 0.27 ppm at 14 DAT2 to <0.05 at 51 DAT3. The resulting analytical values for the avian food from the control plot showed apparent residues of CL 303630 at or below 0.013 ppm in all commodities examined. The LOD was estimated to be 0.003 ppm for this study.

Each spray tank solution was analyzed in duplicate by ACCO personnel using Method M 2260. Monitoring of each application was performed by taking duplicate tank-mix samples before and after the applications. Concentrations of CL 303630 in tank mix samples taken before and after each application averaged 91% (S.D. = 3), 79% (S.D. = 3), and 79% (S.D. = 13) of theory for each of the three applications, respectively. These samples were analyzed to assess homogeneity and stability of the test substance during application. Analytical results for these analyses are presented in Table VII.

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Report Title:	**Residues of AC 303630 in Insects and Their Dissipation after Single Applications of PIRATE® Insecticide-Miticide (AC 303630 3SC) to Cotton Under Field Conditions**
Report Number:	ECO 95-127; MRID No. 44452609
Authors:	J.A. Gagne, R.R. Troup, L.G. Henry, K. Koktavy.

Report Summary

Dissipation in Insects. A non-guideline GLP study was carried out in cotton in Georgia, U.S.A. The objective of this study was to determine the level of residues of AC 303630 in or on insects following application of two rates of PIRATE® (AC 303630 3SC, equivalent to AC 303630 24SC) and up to 28 days post-application to evaluate potential exposure to birds.

Residues were measured in or on beet armyworm (Spodoptera exigua) larvae and adults and cotton leaves immediately following applications at 0.22 kg a.i../hectare (0.2 lb a.i../acre) and 0.39 kg a.i../hectare (0.35 lb a.i./acre) made on 20 and 22 August, 1995. Samples of larvae were collected 0, 1, 3, 4, 8, 15, 22, and 29 days following application, and samples of moths were collected 0, 6, 15, 21, and 28 days following applications. Cotton leaf samples were collected from larval plots on –1, 0, 1, 4, 8, 15, 22, and 29 days after treatment and from moth plots on –3, 0, 6, 15, 21, and 28 days post-treatment to determine the amount of AC 303630 potentially available to insects and to determine the decline of the residues over time. Larval exposure was measured by either placing the larvae on the plants in the field, or removing the leaves from the plants and then placing the larvae on the leaves for a known amount of time in the laboratory. The second method was adopted during the later collection periods to counteract larvae dispersing off the plants to the soil. Moth exposure was determined by releasing moths into enclosures with treated cotton for known periods.

Tank mix samples from spray solutions applied to larval plots were within 12.3% of nominal, and samples from spray solutions applied to moth plots were within 16.2% of nominal. Therefore, nominal rates will be used. Some sampling dates varied slightly from the designated sampling intervals of –1, 0.1, 1, 3, 7, 14, 21, and 28 days post-treatment. All results are reported using these designated sampling intervals.

On plots treated with 0.22 kg a.i./ha, maximum residues measured on cotton leaves during each sampling interval declined from 64.8 ppm on day 0.1, through 14.3 ppm on day 1, 9.54 ppm on day 3, 5.85 ppm on day 4, 3.14 ppm on day 7, 0.98 ppm on day 14, 0.584 ppm on day 21, to 0.518 ppm on day 28. Maximum residues in moth samples declined from 7.96 ppm on day 0.1, through 0.0655 ppm on day 7, 0.452 ppm on day 14, 0.532 ppm on day 21, to 0.652 on day 28. Residues in opportunistic

collections of naturally-occurring insects made on day 7 were 0.0925 ppm. Maximum residues in larvae samples declined from 1.87 ppm on day 0.1, through 1.46 ppm on day 1, 0.583 ppm on day 4, 0.179 ppm on day 7, 0.127 ppm on day 14, to 0.0551 ppm on day 21. Sample collected on day 28 had residues <0.05 ppm, which is less than 1/10 the limit of quantitation (LOQ).

On plots treated with 0.39 kg a.i./ha, maximum residues measured on cotton leaves during each sampling interval declined from 71.3 ppm on day 0.1, through 30.6 ppm on day 1, 20.8 ppm on day 3, 23.9 ppm on day 4, 9.51 ppm on day 7, 1.46 ppm on day 14, 1.82 ppm on day 21, to 1.01 ppm on day 28. Maximum residues in moth samples declined from 4.23 ppm on day 0.1, through <0.05 ppm on day 7, 0.704 ppm on day 14, 1.84 ppm on day 21, to 0.152 on day 28. Residues in opportunistic collections of naturally-occurring insects made on days 0.1 and 7 were 7.71 ppm and 0.157, respectively. Maximum residues in larvae samples declined from 3.24 ppm on day 0.1, through 4.34 ppm on day 1, 1.59 ppm on day 4, to 0.352 ppm on day 7. Samples collected on days 14, 21, and 28 had residues <0.05 ppm, which is less than 1/10 the limit of quantitation (LOQ).

Samples of all matrices analyzed contained some level of AC 303630 on the day of application. These initial residues rapidly declined from 39% to 84% by day 3 or 4, and to 83% to 98% by day 7. AC 303630 residues found after day 7 were negligible in all matrices analyzed.

When the residues of AC 303630 found in cotton and residues of AC 303630 found in larvae were evaluated over time, using linear regression, the residues found in each matrix, at each application rate, declined rapidly, with good consistency between the rates.

When the residues of AC 303630 found in larvae samples were compared to the residues found in cotton leaf samples using linear regression, the residues found in the larvae increased with increasing residues in the cotton, but only to a point. As levels of AC 303630 found on the cotton leaf samples increased beyond a threshold level, the residues in the samples of larvae reached a plateau. This is likely due to the circumstance that once a lethal dose of AC 303630 has been ingested by the larvae, feeding ceases. The higher residues of AC 303630 present on cotton leaves do not translate to increased levels of residues in larvae.

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Report Title:	**CL 303630: Evaluation of Residues of AC 303630 and Their Dissipation After Multiple Ground Applications of AC 303630 3SC Insecticide-Miticide in Planted Avian Food Plots in Mississippi. (MS, 1995)**
Report Number:	RES 96-038; MRID No. 44452608
Authors:	T. Mahl; C Elenewski; C. Snipes (SRD); F. Kennedy (ABC)

Report Summary

The purpose of this study is to determine the residues of AC 303630 in avian food items taken from four weed seed plots treated with different amounts of PIRATE® 3SC insecticide-miticide. Three sequential applications of the test substance will be made approximately 7 days apart. Weed seed head and weed seeds will be sampled in-between and after applications. The study protocol, amendments, and deviations containing the appropriate information to fulfill this purpose are included in Appendix A.

The field portion of this study was conducted in Stoneville, Mississippi in Washington County at a test site with a sandy loam texture. AC 303630 3SC insecticide-miticide was applied in three applications to various weed seeds. The rates of application averaged 0.35 lb a.i./A, 0.18 lb a.i./A, 0.035 lb a.i./A, and 0.01 lb a.i./A in approximately 9-10 gallons of spray solution per acre, for total rates applied of 1.0, 0.5, 0.1, and 0.03 lb a.i./A, respectively. From the control and treated plots, weed seed heads, composite and individual weed seeds samples were collected and analyzed for apparent CL 303630 residues according to Cyanamid method M 2478. The method has a validated sensitivity (Limit of Quantitation, LOQ) of 0.05 ppm.
All residue values, summarized in Tables I-III, are discussed in greater detail in the analytical results section found in Appendix B (ABC analytical report #43060).

The analytical results for the composite weed seed heads in the 0.35 lb a.i./A applications showed average apparent residues declined from 42.4 ppm at 1 DAT3 to apparent residues of 5.79 ppm at 28 DAT3. In the 0.18 lb a.i./A applications, average apparent residues declined from 17.4 ppm at 0.1 DAT2 to apparent residues of 1.85 ppm at 28 DAT3. In the 0.035-0.036 lb a.i./A applications, apparent residues declined from 2.52 ppm at 0.1 DAT3 to average apparent residues of 0.44 ppm at 28 DAT3. In the 0.01 lb a.i./A applications, average apparent residues declined from 0.76 ppm at 1 DAT3 to average apparent residues of 0.17 ppm at 28 DAT3.

The analytical results for the composite weed seed samples in the 0.35 lb a.i./A applications were average apparent residues of 24.9 ppm at 0.1 DAT1, 30.5 ppm at 0.1 DAT3, and 14.9 ppm at 7 DAT3. In the 0.18 lb a.i./A applications, apparent residues were 8.63 ppm at 0.1 DAT1, 12.5 ppm at 0.1 DAT3, and 5.35 ppm at 7 DAT3. In the

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0.035-0.036 lb a.i./A applications, apparent residues were 1.43 ppm at 0.1 DAT1, 2.16 ppm at 0.1 DAT3, and 0.87 ppm at 7 DAT3. In the 0.01 lb a.i./A applications, average apparent residues were 0.38 ppm at 0.1 DAT1, 0.76 ppm at 0.1 DAT3, and 0.29 ppm at 7 DAT3.

In each type of weed seed sampled on 0.1 DAT3, the average apparent residues decreased from the 0.35 lb a.i./A application to the 0.01 lb a.i./A application. The average apparent residues decreased in the browntop millet seeds from 14.2 ppm to 0.32 ppm, in the crabgrass seeds from 110 ppm to 1.08 ppm, in the foxtail seeds from 12.4 ppm to 0.32 ppm, and in the goosegrass seeds from 32.6 ppm to 0.86 ppm. The resulting analytical values for the avian food from the control plot showed apparent residues of CL 303630 at or below 0.045 ppm in all commodities examined. The Limit of Detection (LOD) was estimated to be 0.036 ppm for this study.

Each spray tank solution was analyzed in duplicate by ACCO personnel using Method M 2260. Monitoring of each application was performed by taking duplicate tank-mix samples before and after the applications. Concentrations of CL 303630 in tank mix samples taken before and after the 0.35 lb a.i./A application averaged 88% (S.D. = 5), 92% (S.D. = 3), and 67% (S.D. = 16) of theory for each of the three applications, respectively. Concentrations of CL 303630 in tank mix samples taken before and after the 0.18 lb a.i./A application averaged 76% (S.D. = 12), 92% (S.D. = 3), and 73% (S.D. = 10) of theory for each of the three applications, respectively. Concentrations of CL 303630 in tank mix samples taken before and after the 0.035 lb a.i./A application averaged 89% (S.D. = 7), 87% (S.D. = 7), and 81% (S.D. = 3) of theory for each of the three applications, respectively. Concentrations of CL 303630 in tank mix samples taken before and after the 0.01 lb a.i./A application averaged 91% (S.D. = 8), 94% (S.D. = 4), and 96% (S.D. = 3) of theory for each of the three applications, respectively. These samples were analyzed to assess homogeneity and stability of the test substance during application. Analytical results for these analyses are presented in Table IV.